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G92-1100 Sugar Beet Nematode

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Sugar Beet Nematode

Symptoms, life cycle and control of sugar beet nematodes are among the topics covered here.

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The sugar beet nematode, *schachtii*, is a major parasite of sugar beets, causing serious stand and yield reductions. It was first identified in 1859 on sugar beets near Halle, Germany. It was first observed in the United States as early as 1895 and was reported in two fields near Gering, Nebraska in 1926.

Today, *H. schachtii* is present in nearly half the states in the United States and in 39 other sugar beet-growing countries.

Symptoms and Damage

Symptoms and damage: Fields may be uniformly infested, or have one or more localized areas of infestations. Localized infestations may result in well-defined circular or oval areas where plant stands and growth are poor. *H. schachtii* can parasitize roots of plants of all ages. Seedlings may be severely injured or killed, resulting in poor stands. The older the plant when attacked, the less damage will occur.

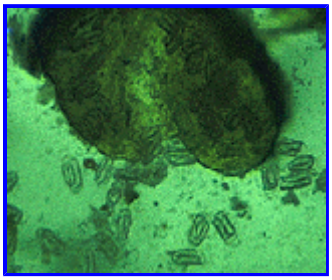

Figure 1. An *H. schachtii* cyst torn open to reveal egg contents. (41K JPG)

Young plants attacked by *H. schachtii* have elongated petioles and remain stunted until harvest. Outer leaves of infected plants usually wilt during the hot period of the day.

Leaves of plants severely attacked have pronounced yellowing. Affected plants have small storage roots and excess fibrous roots often referred to as "bearded" or "whiskered." Early attack of roots often causes severe branching of storage roots. When older plants are attacked, symptoms are less noticeable.

Initial soil population density of approximately 2-4 eggs and/or juveniles in one cubic centimeter of soil may result in economic yield loss. Amount of damage is determined largely by the level of parasitism and the length of favorable environmental conditions. Damage to plants is greatest in a dry summer following a wet spring, which is conducive to the nematode.

Life Cycle

Life cycle: *H. schachtii* is a parasitic roundworm. The nematode overwinters as eggs and juveniles remain dormant inside the cyst *(Figure 1)*, which is the body of the dead female. When the root of a host plant contacts or grows near the cyst, and soil moisture is sufficient, root exudates stimulate juveniles to hatch and emerge from the cyst.

Figure 2. Swollen third stage juvenile breaks outside the root with head still embedded for feeding (stained with acid Fuchsin). (22K JPG)

Juveniles are attracted and migrate to the fibrous roots, infecting near the root tips. After entering the root, they migrate a short distance within the root cortex and begin developing into swollen third stage juveniles *(Figure 2)*. After a fourth molt the female becomes lemon-shaped *(Figure 3)*, and can be seen as a small white dot attached to fibrous roots. Adult males emerge from the root, enter the soil and are attracted to the females, where fertilization occurs.

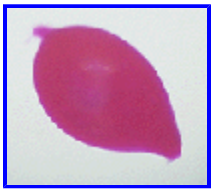

Figure 3. Adult female of *H. schachtii* (stained with acid Fuchsin). (8K JPG)

An average of 200 eggs are produced by one female, a few of which are laid outside the body in the soil. The majority of the eggs remain inside the female. The female dies, her body wall hardens and is transformed into a light brown to reddish brown, lemon-shaped cyst *(Figure 4)*, completing the cycle. Cysts are barely visible with the naked eye. The cycle requires four to six weeks, depending on soil temperature. Three cycles have been reported to occur during the growing season in western Nebraska. *H. schachtii* reproduces best between 70-80°F, but can reproduce between 50-90°F.

Survival in soil: Cysts, containing eggs and/or juveniles, may remain viable in irrigated fields for several years. Annual rate of decline of egg and juvenile populations in soil during rotation usually ranges from 40-60 percent. They survive even longer in fallowed soil.

Survival or rate of decline is influenced by soil temperature, soil moisture, susceptibility of plants (including cultivated crops and weeds), soil type and number of predators and parasites present. Preplant egg and juvenile populations in soil usually range from none to 15 per ml of soil in a corn-bean-sugar beet cropping sequence. Higher numbers are found in shorter rotations.

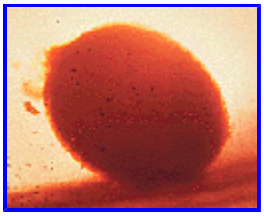

Figure 4. Brown lemon-shaped cyst filled with eggs. (18K JPG)

On an average the economic threshold level in western Nebraska is about 2.8 eggs (including juveniles) per ml of soil. The higher the sugar price and percent sugar and the lower the cost of control, the lower the economic threshold level.

Host range: In Nebraska, *H. schachtii* presently causes economic losses only in sugar beets, but it can attack over 200 plant species in 23 different plant families. Most hosts are found in the Chenopodiaceae family and the Cruciferae family.

In addition to sugar beets, other host crops include turnips, kale, radishes, spinach, broccoli, cabbage, cauliflower, tomatoes, Brussels sprouts, table beets, kohlrabi, rhubarb and other closely related crops. Weed hosts include mustard, pigweed, lambsquarter, shepherdspurse, purslane and other closely related weeds. Good weed control is crucial during rotation if maximum reduction of soil populations of *H. schachtii* is to be obtained.

Distribution and spread: Cysts can be found in the soil profile from the surface down to 24 inches. The greatest concentrations are usually found in the root zone (2-10 inches).

Figure 5. Tare soil from nematode infested fields contains root fragments and associated soil supporting high numbers of egg-filled cysts. (23K JPG)

Spread of cysts may occur in many ways. Long distance spread has most likely been from cysts in soil peds in unclean seed. Other means of spreading soil, such as on machinery, animal hooves, etc., also can result in the spread of *H. schachtii*.

Short distance spread occurs through irrigation water. This can occur throughout the canal system, as well as in surface water within a given field. Other means of spread include wind-blown soil, and from cysts in feces of birds and other animals. Many of the cysts attached to roots are shaken-off during unloading at beet dumps. Therefore, tare soil from infested fields may have a relatively high number of egg-filled cysts *(Figure 5)*.

Control

Sanitation: Tare soil should either be evenly spread over the harvested sugar beet field and planted with a non-host crop for three to five years, or used as fill in washes, barrow pits, etc., on the farm, or taken to a sanitary landfill. Dumping tare soil into fields should be avoided since this can result in "hot spots" for the cyst nematode, Rhizoctonia, and other sugar beet diseases and pests.

Rotation with non-host crops: The most widely used method of control is the rotation out of sugar beets with a non-host crop. Rotation with non-host crops such as wheat, barley, corn, beans or alfalfa will reduce the soil population of *H. schachtii* through natural decline. However, weed hosts must be controlled during the rotation.

Figure 6. Stunted growth of sugar beets (right) compared to excellent growth (left) following a nematicide treatment. (27K JPG)

The number of years of rotation out of sugar beets will depend on the density of cysts in the soil. Once the population density has been determined, the number of years a non-host crop must be grown to reduce the population below the 2-4 eggs or juveniles per gram of dry soil can be estimated using the 50 percent annual decline rate. However, the actual nematode soil population in a given field must be determined by a laboratory analysis. A rotation of three to four years is usually required.

Early planting: Planting early when soil temperatures are relatively cool (below 60^{o}F) greatly reduces damage from *H. schachtii*. Plants can better tolerate attack by *H. schachtii* at a later age. The younger the plant is when parasitism occurs, the greater the damage and loss will be.

Nematicides: Applying nematicides is useful, particularly in short rotations and when the cyst or egg population is above the recommended threshold prior to planting sugar beets *(Figure 6)*. Several nematicides and insecticide/nematicides are labeled for the control of *H. schachtii* on sugar beets. Nematicides that have proven effective in western Nebraska are given in *Table I.*

In Nebraska, Temik is the most widely used granular at-plant nematicide, partly because of its dual activity on both nematodes and insects. Temik, applied at the recommended rate of 27 lbs/acre, inhibits the hatching of juveniles and disorients juveniles and adult males in the soil. When taken up by the plant, Temik becomes systemic and inhibits the development of *H. schachtii* after penetration into the sugar beet root.

Table I. Nematicides and recommended rates for sugar beet nematiode.

Nematicide	Rate
Telone II soil fumigant	12-15 gal/acre
Temik 15G	18-22 oz/1,000 ft of row
Counter 15G (for suppression of moderate populations)	18 oz/ 1,000 ft of row
Counter 20CR (for suppression of moderate populations)	12 oz/ 1,000 ft of row

Temik is applied in a band at-plant and incorporated. The label also allows an at-plant + sidedress application. Counter is registered for suppression of the sugar beet nematode and is useful for low to moderate nematode populations.

Soil fumigants such as Telone II must be applied in either the fall or pre-plant during the early spring. Effectiveness of fumigants depends on the depth of application, soil temperature and moisture, soil type, compaction and organic matter content. Telone II can be applied by chisel or moldboard plow. It is extremely important to seal the soil surface with presswheels following chisels or a harrow following moldboard plow application. Fumigants usually are more expensive than granular materials.

Label directions for use of all nematicides must be strictly adhered to for maximum efficacy and operator safety.

Trap crops: Oil radish and yellow mustard "trap crops" have been developed and used in Germany to control the sugar beet nematode, and are being researched for possible use in the United States. Roots of the trap crop mimic those of a host crop by producing root exudates that stimulate eggs to hatch and attract juveniles to the roots. After penetration, however, juveniles fail to develop into adults and reproduction does not occur.

Trap crops, when used in conjunction with the rotation of a non-host crop, should further lower the soil population of *H. schachtii* and reduce the need for, or the amount of nematicide required, in the following sugar beet crop.

Tests are being conducted in western Nebraska on planting dates and effects on nematode population levels. Research is also being conducted in adjacent areas in Wyoming. Use of trap crops has proven effective in Europe and in Idaho, and similar results are anticipated in Nebraska and Wyoming. **Methods of incorporating trap crops into cropping systems must be developed before they can be recommended for grower use.**

Oil radish and mustard trap crop varieties were developed specifically for the sugar beet cyst nematode. Nebraska studies indicate they have little effect on the false root-knot nematode. Growers should be aware of mixed populations of those two nematode species when choosing control methods.

Resistant sugar beet cultivars: Although research is being conducted toward the development of resistant cultivars, none are currently available.

Integrated control: A combination of rotation with non-host crops, good weed control, and planting a trap crop when available all will reduce the soil population of *H. schachtii*. Laboratory analysis of soil should be made to determine nematode density, when sugar beets can be planted safely, and the need for a nematicide application. Early spring seeding should result in better plant stands and healthier sugar beet plants.

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